



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



Publication number: **0 404 166 A3**

(12)

## EUROPEAN PATENT APPLICATION

(21) Application number: 90111798.6

(51) Int. Cl. 5: **F16C 11/10**

(22) Date of filing: 21.06.90

(30) Priority: 23.06.89 JP 162227/89

Kawasaki-shi(JP)

(43) Date of publication of application:  
27.12.90 Bulletin 90/52

(72) Inventor: Kobayashi, Takaichi, c/o Intellectual  
Property Div.

(84) Designated Contracting States:  
DE FR GB IT

Kabushiki Kaisha Toshiba, 1-1 Shibaura  
1-chome  
Minato-ku, Tokyo 105(JP)

(98) Date of deferred publication of the search report:  
11.12.91 Bulletin 91/50

(74) Representative: Henkel, Feiler, Hänzel &  
Partner

(71) Applicant: Kabushiki Kaisha Toshiba  
72, Horikawa-cho Saiwai-ku

Möhlstrasse 37  
W-8000 München 80(DE)

(54) Hinge device having mechanism for stopping movable member at open position.

(57) A hinge device comprising a shaft (63) to be connected at one end to a first member (2), a bracket mounted on the shaft (63), for supporting a second member (8) such that the second member (8) rotates around said shaft (63), and wave washers (77) held and compressed between said shaft (63)

and said support means (64). The wave washers (77) generates a friction between said shaft (63) and the second member (8) when the first and second members (2, 8) are rotated relative to each other around said shaft (63), thus suppressing the rotation of the first and second members (2, 8).

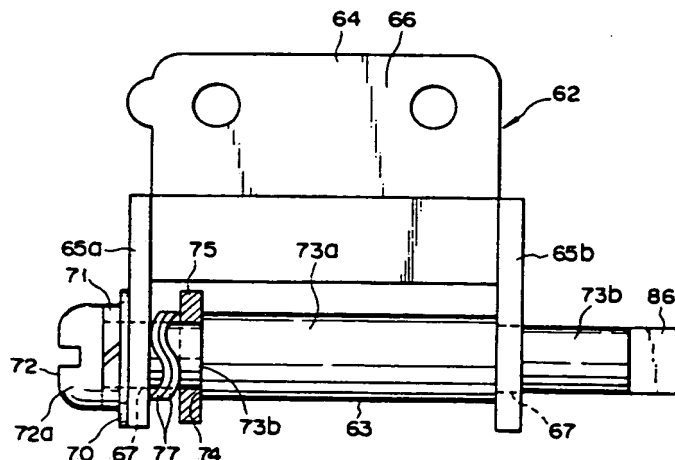


FIG. 5

EP 0 404 166 A3





European  
Patent Office

## EUROPEAN SEARCH REPORT

Application Number

EP 90 11 1798

### DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	FR-A-2 614 077 (ETABLISSEMENTS TREVES S.A.) " whole document "	1-3,5, 8-10	F 16 C 11/10
A	CH-A-4 937 51 (W. DALCHER) " pages 1,2; figures 1,2 "	4,6,7	
D,A	US-A-4 571 456 (D.C. PAULSEN) " abstract; figures 1,22 "	11	
A	DE-A-2 402 815 (BRAUN AG)		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F 16 C G 06 F E 05 D
Place of search		Date of completion of search	Examiner
Berlin		23 September 91	HOFFMANN M.P.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone		E : earlier patent document, but published on, or after the filing date	
Y : particularly relevant if combined with another document of the same category		D : document cited in the application	
A : technological background		L : document cited for other reasons	
O : non-written disclosure			
P : intermediate document		& : member of the same patent family, corresponding document	
T : theory or principle underlying the invention			



③



Europäisches Patentamt  
European Patent Office  
Office européen des brevets

④

Publication number:

**0 404 166  
A2**

②

## EUROPEAN PATENT APPLICATION

①

Application number: **90111798.6**

⑤

Int. Cl.<sup>5</sup>: **F16C 11/10**

②

Date of filing: **21.06.90**

③

Priority: **23.06.89 JP 162227/89**

④

Date of publication of application:  
**27.12.90 Bulletin 90/52**

⑥

Designated Contracting States:  
**DE FR GB IT**

⑦

Applicant: **Kabushiki Kaisha Toshiba**  
**72, Horikawa-cho Saiwai-ku**  
**Kawasaki-shi(JP)**

⑧

Inventor: **Kobayashi, Takaichi, c/o Intellectual**  
**Property Div.**  
**Kabushiki Kaisha Toshiba, 1-1 Shibaura**  
**1-chome**  
**Minato-ku, Tokyo 105(JP)**

⑨

Representative: **Henkel, Feiler, Hänzel &**  
**Partner**  
**Möhlstrasse 37**  
**D-8000 München 80(DE)**

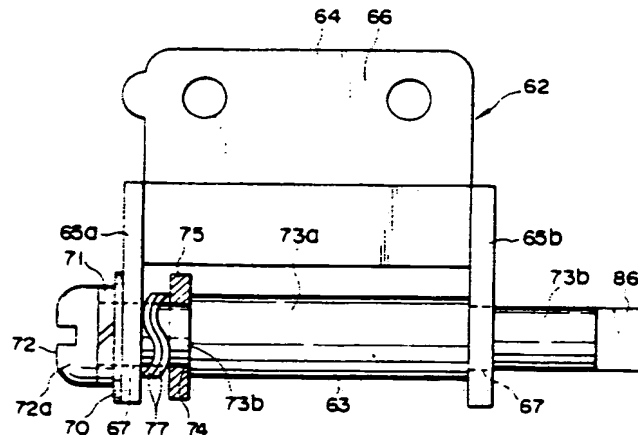
⑩

**Hinge device having mechanism for stopping movable member at open position.**

⑪

A hinge device comprising a shaft (63) to be connected at one end to a first member (2), a bracket mounted on the shaft (63), for supporting a second member (8) such that the second member (8) rotates around said shaft (63), and wave washers (77) held and compressed between said shaft (63)

and said support means (64). The wave washers (77) generates a friction between said shaft (63) and the second member (8) when the first and second members (2, 8) are rotated relative to each other around said shaft (63), thus suppressing the rotation of the first and second members (2, 8).



**FIG. 5**

# Hinge device having mechanism for stopping movable member at open position

The present invention relates to a hinge device for use in a portable apparatus such as a lap-top or portable personal computer and more particularly to a hinge device having a mechanism for stopping a movable member of the apparatus at an open position, by virtue of the frictional force exerted by a spring member.

U.S. Patent 4,571,456 discloses a portable personal computer which comprises a rectangular case, a keyboard attached to the case, and a display unit hinged to the case by a hinge.

Connected by the hinge to the case, the display unit can rotate between a position (hereinafter referred to as "closed position") where it covers the keyboard and a position (hereinafter referred to as "opened position") where it stands upright at the rear of the keyboard. The hinge includes a mechanism which exerts a frictional force to stop the display unit at any position between the closed position and the open position.

A hinge having such a mechanism and designed to connect a display unit to the case of a personal computer is disclosed in Published Unexamined Japanese Patent Application No. 59-99111. This hinge comprises a shaft and a coil spring wound around the shaft. The shaft is fastened at one end to the display unit and at the other end to the case. As the display unit is rotated upward, the coil spring is wound more and more tightly around the shaft, whereby a frictional force is generated between the shaft and the coil spring. By virtue of this force, the display unit is held up at a position where the user takes his or her hand off the display unit, provided that the hinge shaft and the coil spring have a proper outside diameter and an appropriate inside diameter, respectively, and are set at correct positions. It requires much time and labor to make the shaft and the spring with sufficient precision and to set them in a correct positional relationship. Consequently, the manufacturing cost of the hinge is inevitably high.

The object of the present invention is to provide a hinge device whose components need not be machined or positioned with high-precision, and which is therefore easy to manufacture and can, thus, be manufactured at low cost.

According to the invention, there is provided a hinge device comprising: a shaft to be connected at one end, to a first member; support means mounted on the shaft, for supporting a second member such that the second member rotates around the shaft; and ring-shaped spring means held and compressed between the shaft and the support means, for generating a friction between said shaft and said support means when the first and second

members are rotated relative to each other around the shaft, thereby to suppress the rotation of the first and second members.

The ring-shaped spring means can easily be incorporated in the hinge device, when pushed into the gap between the shaft and the support means. Once so incorporated, the ring-shaped spring means can exert a frictional force between the shaft and the support means. Unlike the coil spring used in the conventional hinge described above, the spring means need not be machined or positioned with high precision.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view illustrating a personal computer having a hinge device according to the present invention;

Fig. 2 is a sectional view schematically showing a hinge device according to a first embodiment of the present invention;

Fig. 3 is a sectional view, taken along line III-III in Fig. 2;

Fig. 4 is an exploded view illustrating the hinge device shown in Fig. 2;

Fig. 5 is a plan view of the hinge device shown in Fig. 2;

Fig. 6 consists of a perspective view showing a part of the case of the computer and an exploded view showing hinge mechanism for connecting a display unit to the case;

Fig. 7 is a sectional view schematically showing how the the housing and display unit of the personal computer are coupled to each other;

Fig. 8 is an exploded view showing the leg section which supports the display unit;

Fig. 9 is another sectional view, explaining how the cable is guided from the housing into the display unit through the hinge device shown in Figs. 6 and 7;

Fig. 10 is a sectional view, taken along line X-X in Fig. 7;

Fig. 11 is a sectional view showing the shaft and other components of the hinge device shown in Figs. 6 and 7;

Fig. 12 is a partially sectional, side view of the display unit;

Fig. 13 is a plan view showing a hinge device according to a second embodiment of the invention; and

Fig. 14 is a plan view illustrating a hinge device according to a third embodiment of the invention.

Fig. 1 illustrates a lap-top or portable personal

computer 1. The computer 1 has a case 2 made of a synthetic resin and is shaped like a thin rectangular box comprising a bottom case 3 which is covered by a top cover 4. A keyboard 5 is attached to the front half of the top cover 4. The rearmost part of the half of the top cover 4 is thicker than the front most part of the rear half. Two recesses 6a and 6b are formed in the front-left and -right portions of the rear half of the top cover 4, respectively. As is shown in Fig. 7, a printed circuit board 7, on which are mounted a number of circuit parts (not shown), is incorporated in the case 2.

As is illustrated in Fig. 1, the computer 1 further comprises a flat-panel type display unit 8 located at the rear of the keyboard 5. The display unit 8 comprises a rectangular housing 9 and a flat liquid-crystal display 11 located within the housing 9. The housing 9 is composed of a base panel 10a and a front panel 10b, both shaped like a rectangular plate. These panels 10a and 10b are fastened together, by means of screws (not shown) at their four corners. The liquid-crystal display 11, which has a screen 12, is inter posed between the panels 10a and 10b. The screen 12 is exposed through the rectangular opening 13 made in the front panel 10b.

As is evident from Fig. 1, the display unit 8 is attached to the case 2 such that it rotate between a position (hereinafter referred to as "closed position") where it covers the keyboard 6 and a position (herein after referred to as "opened position") where it stands upright at the rear of the keyboard 5. The display unit 8 covers the entire keyboard 5 when it is rotated to the closed position. As long as the unit 8 remains in the closed position, its top is at the same level as the upper surface of the top cover 4, and its left and right sides are level with those of the top cover 4. In this condition, the case 2 and the display unit 8 form a relatively thin box, which is quite portable.

As is shown in Figs. 2 and 6, a pair of leg sections 15a and 15b protrude from the lower-left and lower-right portions of the housing 9, with their lower ends located in the recesses 6a and 6b of the case 2. The leg sections 15a and 15b will henceforth be described in detail.

As is evident from Fig. 6, the leg section 15a is formed of a rear leg segment 16 protruding from the base panel 10a and being integral therewith, and a front leg segment 17 removably fastened to the front of the rear leg segment 16. As Fig. 6 clearly shows, the front leg segment 17 has a claw 18 projecting from the side which connects to the rear leg segment 16. The claw 18 is positioned so that it engages the lock hole 19 formed in the inner side of the rear leg segment 16, with respect to the display unit 8 whereby the segments 16 and 17 are fastened together, forming the leg section 15a. The

leg segments 16 and 17, thus fastened together, define a guide path 20.

The front leg segment 17 also has a guide portion 21 for guiding a cable into the housing 9. The guide portion 21 has a communication port 22 at its tip. The port 22 opens to the interior of the housing 9, thus allowing the guide path 20 to communicate with the interior of the housing 9. The segment 17 further has a fixing tongue piece 24 which is attached to the guide portion 21 and aligns with the boss 23 protruding from the base panel 10a, and has a positioning hole 25. A positioning projection 26, protruding from the base panel 10a, is inserted in the hole 25, thereby aligning the front leg segment 17 with respect to the rear leg segment 16. As a result of this, the leg segments 16 and 17 are firmly connected by means of a screw 27 set in screw 27 engagement with the boss 23, thus forming the leg section 15a.

As is illustrated in Fig. 8, the stepped portion of the front leg segment 17, which is continuous to the guide portion 21, has a hole 28 opening into the interior of the leg segment 17. A tongue piece 29, protruding from the front panel 10b, is inserted in the hole 28, thus positioning the front panel 10b with respect to the base panel 10a.

As may be understood from Fig. 6, the leg segments 16 and 17 have, respectively half-cylinders 31a and 31b, which are situated on the outer sides and connected to each other. The half-cylinders 31a and 31b define U-shaped notches 30a and 30b. These half-cylinders 31a and 31b form a hollow shaft 32 having a guide path 33. The guide path 33 communicates with the guide path 20 defined by the leg segments 16 and 17.

As is best shown in Fig. 6, the half-cylinder 31a of the rear leg segment 16 has two arcuate projections 34a and 34b opposing each other and extending into the front leg segment 17. Thus, as is illustrated in Fig. 12, the distance L1 between the tips of the arcuate projections 34a and 34b is shorter than the inside diameter L2 of the hollow shaft 32.

The leg section 15a of the housing 9 extends into the recess 6a of the case 2. As is evident from Fig. 6, an opening 38 is formed in the recess 6a. This opening 38 consists of two sections 39 and 40. The section 39 is cut in the outermost of the two opposing side walls which define the inner and outer faces of the recess 6a with respect to the case 2, and the section 40 is made in the face which defines the bottom of the recess 6a. The upper edge of the section 39, or receiving section 41, is arcuate, so that the shaft 32 is rotatably fitted in the opening 38.

A support 43, which is made of a synthetic resin, is located in the opening 38, extending from below the top cover 4. The support 43 is fastened

to the wall defining the bottom of the recess 6a, and consists of a side wall 44 and a bottom 45 which are fitted in the sections 39 and 40 of the opening 38, respectively, and two flanges 46, connected to the front and rear edges of the section 39, and fastened to the bosses 47 which protrude downward from the inner surface of the top cover 4, by means of screws 48.

An arcuate notch 50, into which the shaft 32 is rotatably fitted, is cut in the upper edge of the side wall 44, so as to oppose the receiving section 41 in the case 2, and this notch 50 and the section 41 form a circular hole 51, through which the shaft 32 rotatably extends. A guide wall 52, which is taller than the side wall 44 and also has an arcuate notch, is formed integral with the wall 44.

The hole 51 communicates with the guide path 20 formed in the leg section 15a through the guide path 33 formed in the shaft 32. Hence, the guide paths 20 and 33 and the hole 51 connects the interior of the case 2 to that of the housing 9, and a cable 53 extends through the paths 20 and 33 and the hole 51, thus electrically connecting the printed circuit board 7 to the liquid-crystal display 11. The cable 53 is flexible and has connectors 54a and 54b attached to its ends as is shown in Fig. 7. The connectors 54a and 54b are elongated members than the hole 51. The connector 54a extends into the case 2 and is connected to the printed circuit board 7, and the connector 54b extends into the housing 9 and is connected to the liquid-crystal display 11.

It will now be explained how the cable 53 is guided from the case 2 into the housing 9 of the display unit 8, with display unit 8 disconnected from case 2.

First, the front panel 10b and the front leg segment 17 are removed from the base panel 10a of the housing 9. Also, the top cover 4 is detached from the bottom case 3. Further, the support 43 is removed from the top cover 4, thus allowing access to the interior of the case 2 through the opening 38 which is, as is shown in Fig. 6, formed in the left of the two opposing side walls which define the left and right faces of the recess 6a, and the the wall which define the bottom of the recess 6a. The opening 38 is larger than the connector 54a to be attached to the printed circuit board 7. That end portion of the cable 53 to which the connector 54a is connected is inserted into the case 2 through the opening 38.

Next, the support 43 is fitted into the opening 38 from within the top cover 4, with the cable 53 rested in the U-notch 50 of the support 42. The flanges 46 of the support 43 are then fastened to the bosses 47 by screws 48. As a result, the support 43 is secured to the housing 9, whereby the U-notch 50 of the support 43 and the receiving

section 41 of the top cover 4 define the hole 51, and the cable 53 passes through this hole 51.

Then, the cable 53 is pushed into the half-cylinder 31a of the rear leg segment 16, more precisely into the gap between the arcuate projections 34a and 34b. Once the cable 53 is thus pushed into the half-cylinder 31a, it can hardly slip out of it since the distance L2 between the tips of the arcuate projections 34a and 34b is shorter than the inside diameter L1 of the hollow shaft 32. The rear leg segment 16 is inserted into the recess 6a, thus fitting cylinder 31a into the hole 51.

Thereafter, the cable 53 is guided through the rear leg segment 16 to a position above the base panel 10a. This done, the front leg section 17 is fastened to the rear leg section 16 by means of the screw 27, thus fitting the half-cylinder 31b into the hole 51. The half-cylinders 31a and 31b form the hollow shaft 32 having the guide path 33, through which the cable 53 extends into the housing 9 of the display unit 8. Thus, the cable 53 is guided from the case 2 into the housing 9 through the leg section 15a.

As is illustrated in Figs. 2 and 3, the leg section 15b of the housing 9 is composed of a rear leg segment 60 formed so as to be integral with the base panel 10a and a front leg segment 61 formed so as to be integral with the front panel 10b, and is similar to the leg section 15a in structure. The leg section 15b extends horizontally longer than the leg section 15a, and contains a pair of hinge mechanisms 62, which support the housing 9 such that it can be rotated upward from the other case 2 and downward thereto.

The first and second hinge mechanisms are located in the inner and outer ends of the leg section 15b, respectively. The hinge mechanism 62 is designed not only to support the housing 9, but also to hold it at any position between the closed position and the opened position. The hinge mechanisms 62 are identical in structure, and only one of them will, therefore, be described in detail with reference to Fig. 5.

As is illustrated in Fig. 5, either hinge mechanism 62 has a straight shaft 63 and a bracket 64 made of metal and supporting the shaft 63. The bracket 64 comprises a pair of support pieces 65a and 65b spaced apart in the axial direction of the shaft 63, and a fixing section 66 connecting these pieces 65a and 65b. The support pieces 65a and 65b each have a hole 67, and are so positioned that the holes 67 are coaxial. The ends of the shaft 63 are rotatably supported in these holes 67.

The left end of shaft 63 has a screw hole, and a screw 72 is inserted in this hole, with a plain washer 70 and a spring washer 71 interposed between it and the left end of the shaft 63. The plain washer 70, the spring washer 71, and the head 72a



of the screw 72 have diameters larger than those of holes 67. Hence, the plain washer 70 abuts on the outer side of support piece 65a, whereby the washers 70 and 71 and the screw 72 prevent the shaft 63 from slipping from the hinge mechanism 62.

The shaft 63 consists of three portions, i.e., a thick portion 73a and two thin portions 73b extending from the ends of the portion 73a. The first thin portion 73b is inserted in the hole 67 of the support pieces 65b, and the second thin portion 73b is inserted in the hole 67 of the support piece 65a. A plain washer 75 having an outside diameter larger than the diameter of the thick portion 73a is mounted on the thin portion 73b and abuts the right end 74 of the thick portion 73a. Two wave washers 77 having an outside diameter substantially the same as the diameter of the thick portion 73a are mounted on the thin portion 73b and compressed between the plain washer 75 and the support piece 65a of the bracket 64. The two wave washers 77, which function as springs, abut on the plain washer 75 and the support piece 65a, respectively. A friction force is thereby generated between the plain washer 75 and the bracket 64, restricting the rotation of the shaft 63 which is supported by the bracket 64.

In this embodiment, two wave washers 77 are used to restrict the rotation of the shaft 63. Alternatively, one wave washer, or three or more wave washers may be used for the same purpose in the present invention.

As is shown in Fig. 2, two pairs of bosses 80 protrude from the inner surface of the rear leg segment 60. The fixing sections 66 of the first and second hinge mechanisms 62 are fastened to the first and second pairs of bosses 80, respectively, by means of screws 81, whereby both hinge mechanisms 62 are coupled to the housing 9. As is shown in Fig. 3, one of the screws 81 which fasten either fixing section 66 to the bosses 80 passes through the hole cut in the front leg segment 61, and thus fastens the front leg segment 61 to the rear leg segment 60. A decoration cover 82 is removably connected to the front leg segment 61, thus concealing the heads 81a of the screws 81.

As is illustrated in Fig. 2, one of the thin portions 73b of either shaft 63 extends into case 2 through the hole 85 made in the side wall of case 2. That end 86 of the portion 73b which is located within the case 2 has a polygonal cross section. The end 86 of the thin portion 73b is fitted in the corresponding hole 88 made in the support 87 which protrudes downward from the top wall of case 2. Thus, the shaft 63 of the hinge mechanism 62 cannot rotate.

The display unit 8 has its leg section 15a connected to the case 2 by means of the shaft 32 held in the hole 51 as is shown in Figs. 6 and 7,

and has its leg section 15b connected to the case 2 by means of the hinge mechanisms 62 as is shown in Figs. 2 and 3. The unit 8 is thus rotatably supported on the case 2.

It will now be explained how either hinge mechanisms 62 operate to hold the display unit 8 at any desired position between the closed position and the opened position.

When the display unit 8 is rotated from the closed position toward the opened position, the bracket 64 of the mechanism 62, which is fastened to the base panel 10a, rotates around the shaft 63, allowing the unit 8 to rotate to any position between the closed position and the opened position, so that the user of the personal computer can see clearly the data displayed on the liquid-crystal display screen 12.

Since the wave washers 77 are interposed and compressed between the plain washer 75 mounted on the shaft 63 and the support piece 65a of the bracket 64, a frictional force is generated between the bracket 64 and the plain washer 75. This force suppresses the rotation of the bracket 64, whereby the display unit 8 remains at the position where the user takes his or her hand off the display unit 8.

The two wave washers 77 can easily be incorporated in the hinge mechanism 62, when pushed into the gap between the support piece 65a and the plain washer 75. Once so incorporated, the washers 77 can exert a frictional force between the shaft 63 and the bracket 64. Unlike the coil spring used in the conventional hinge described above, the wave washers 77 need not be machined with high precision, or positioned in the hinge mechanism 62 with high precision. Therefore, the hinge mechanism 62 can be manufactured at lower cost than the conventional hinge.

Further, since the total thickness of the two wave washers 77 is far less than the length of the coil spring wound around the hinge shaft in the conventional hinge, the hinge mechanism 62 is much shorter than the conventional hinge.

Fig. 13 illustrates a hinge mechanism according to a second embodiment of the invention. This mechanism is different from the first embodiment (Fig. 5), in that a flange 91 is formed integral with the shaft 63, located between the thick portion 73a and the thin portion 73b, and has a larger diameter than the thick portion 73a. Two wave washers 77 are mounted on the thin portion 73b and compressed between the flange 91 and the support piece 65a of the bracket 64.

Fig. 14 shows a hinge mechanism according to a third embodiment of the invention, which is identical to the first embodiment (Fig. 5), except that a Belleville spring 100 is used in place of wave washers.

The hinge device according to the invention

can be used, not only in personal computer, but also in word processors, reclining seats, and the like.

## Claims

1. A hinge device having a shaft (63) to be connected at one end to a first member (2), and support means (64) mounted on the shaft (63), for supporting a second member (8) such that the second member (8) rotates around said shaft, characterized by further comprising: ring-shaped spring means (77, 100) held and compressed between said shaft (63) and said support means (64), for generating a friction between said shaft (63) and said support means (64) when the first and second members (2, 8) are rotated relative to each other around said shaft (63), thereby to suppress the rotation of the first and second members (2, 8).

2. The hinge device according to claim 1, characterized in that said ring-shaped spring means (77, 100) comprises at least one wave washer (77).

3. The hinge device according to claim 1, characterized in that said ring-shaped spring means (77, 100) is a belleville spring (100).

4. The hinge device according to claim 1, characterized in that said ring-shaped spring means comprises (77, 100) a plurality of wave washers (77) stacked, one upon another, in the axial direction of said shaft (63).

5. The hinge device according to claim 1, characterized in that said support means (64) includes a bracket (64) fastened to the second member (8).

6. The hinge device according to claim 5, characterized in that said bracket (64) comprises a pair of support pieces (65a, 65b) spaced apart in the axial direction of said shaft (63), and a fixing section (66) connecting the support pieces (65a, 65b) and fastened to the second member (8).

7. The hinge device according to claim 6, characterized in that said support pieces (65a, 65b) each have a through hole (67), and the end portions of said shaft are rotatably inserted in the through holes of said support pieces.

8. The hinge device according to claim 1, characterized in that said shaft has stopper means (75, 91) extending in the radial direction of said shaft (63), and the said ring-shaped spring means (77, 100) abuts the stopper means.

9. The hinge device according to claim 8, characterized in that said shaft has a thin portion (73b) and a thick portion (73a), and said stopper means (75, 91) comprises a plain washer (75) mounted on the thin portion (73b), having an outside diameter greater than the thick portion (73a) of the shaft, and located at the border between the thin and thick

portions (73a, 73b) of the shaft (63).

10. The hinge device according to claim 8, characterized in that said stopper means (75, 91) is a flange (91) mounted on said shaft (63) and integral therewith.

11. A hinge device for use in a personal computer comprising a case (2) and an image-displaying unit (8), said hinge device designed to connect the image-displaying device (8) rotatably to the case (2) and comprising:

a shaft (63) to be connected at one end to the case (2);

support means (64) mounted on the shaft (63), for supporting the image-displaying unit (8) such that the image-displaying unit (8) rotates around said shaft (63); and

ring-shaped spring means (77, 100) held and compressed between said shaft (63) and said support means (64), for generating a friction between said shaft (63) and said support means (64) when the case (2) and the image-displaying unit (8) are rotated relative to each other around said shaft (63), thereby to suppress the rotation of the case (2) and the image-displaying unit (8).

5

10

15

20

25

30

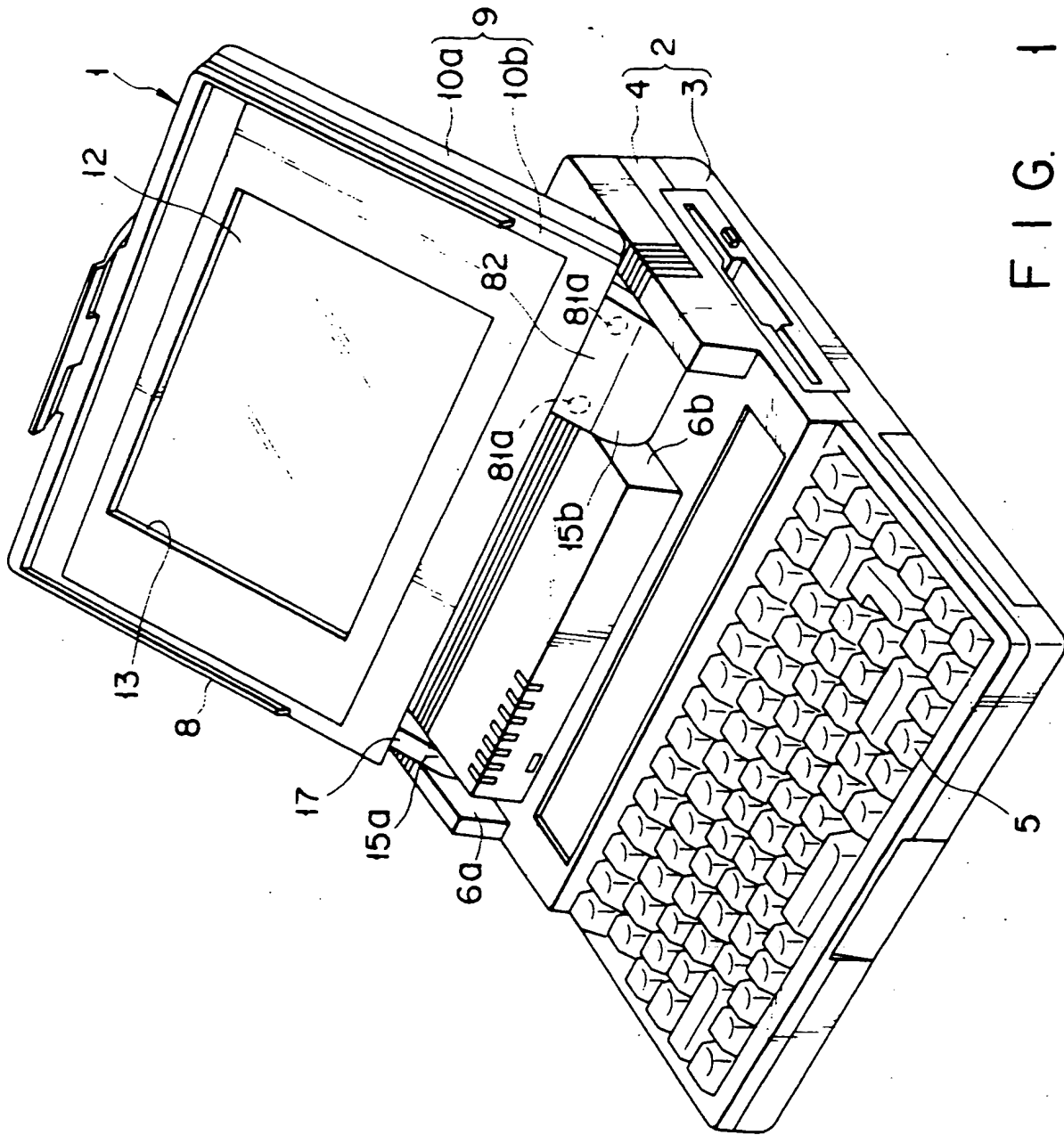
35

40

45

50

55





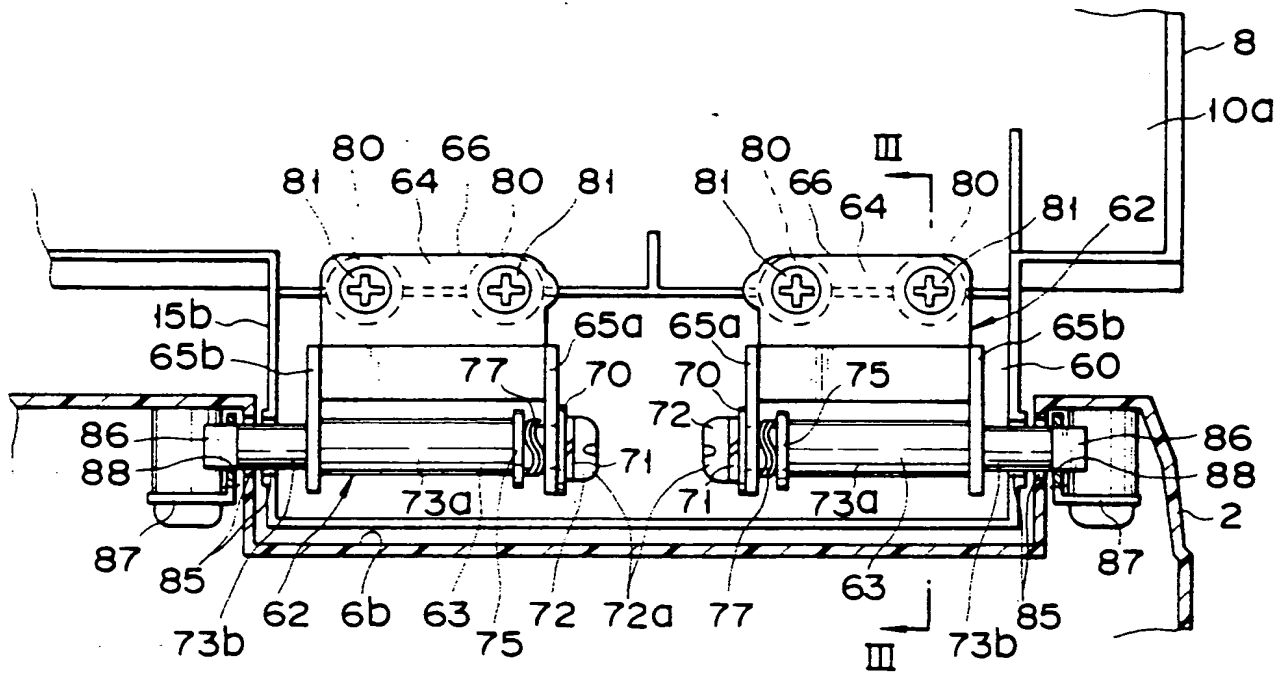


FIG. 2

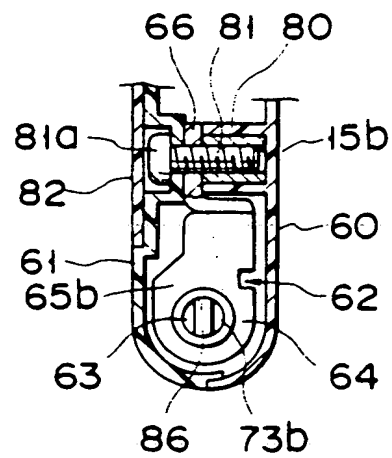


FIG. 3



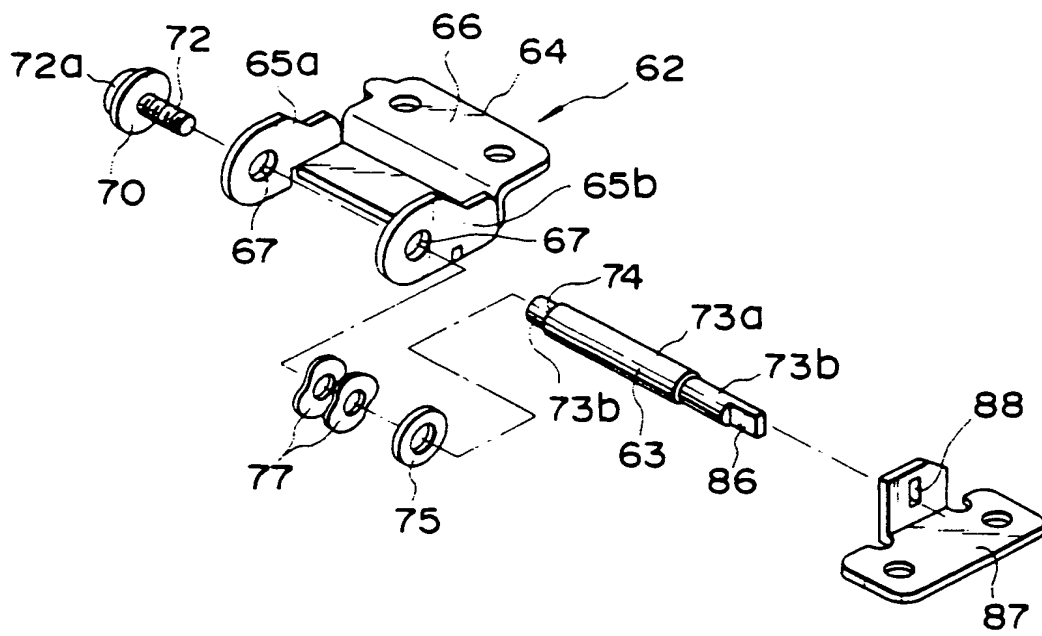


FIG. 4





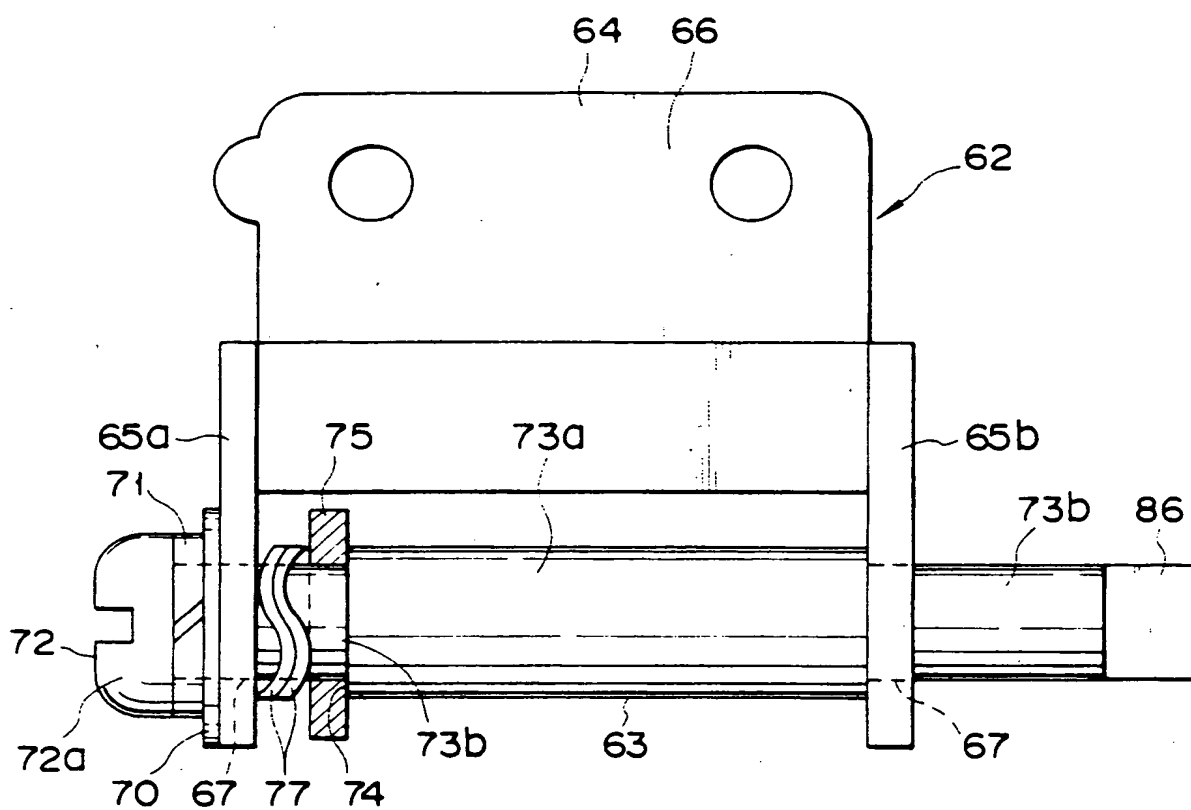


FIG. 5



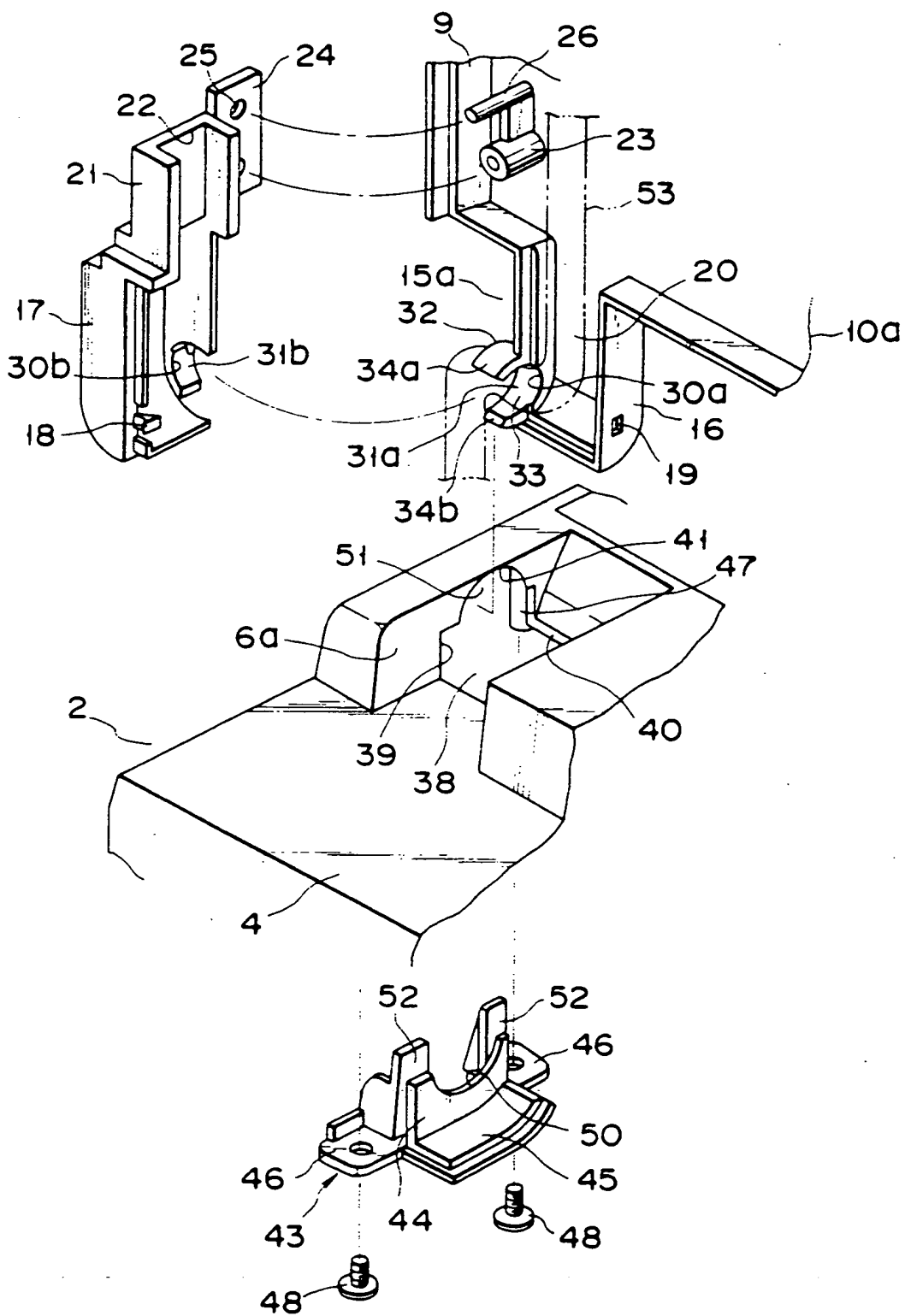


FIG. 6



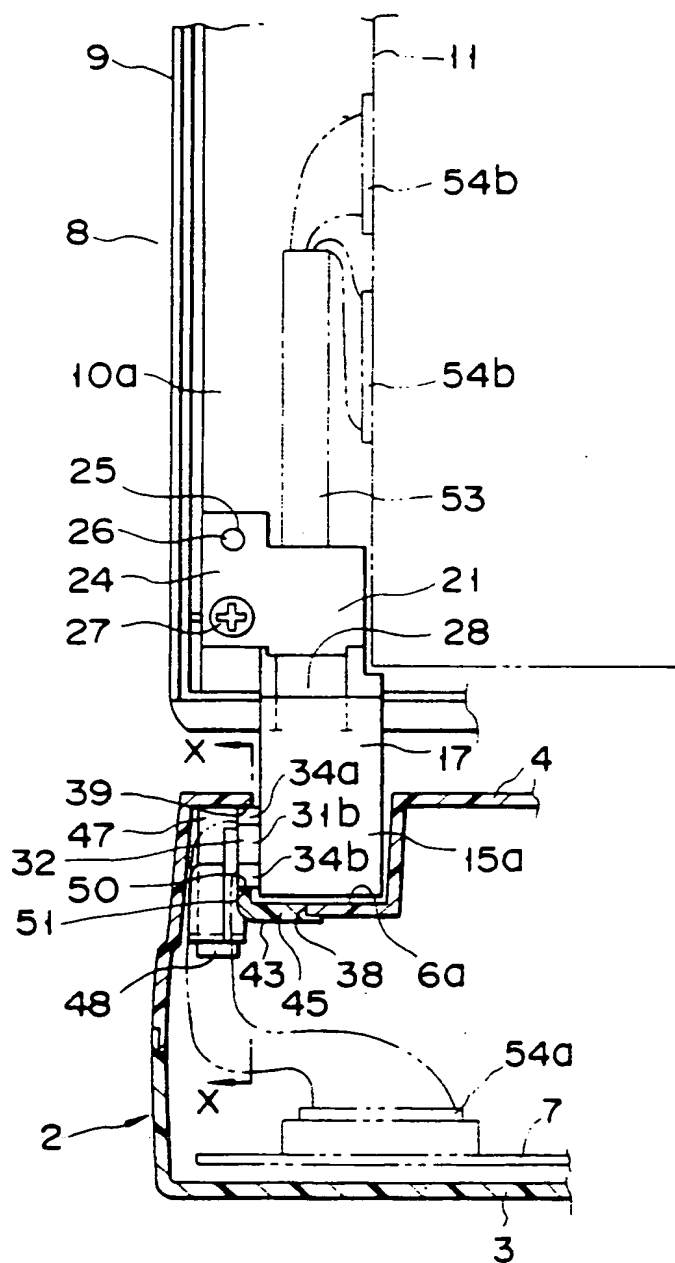


FIG. 7



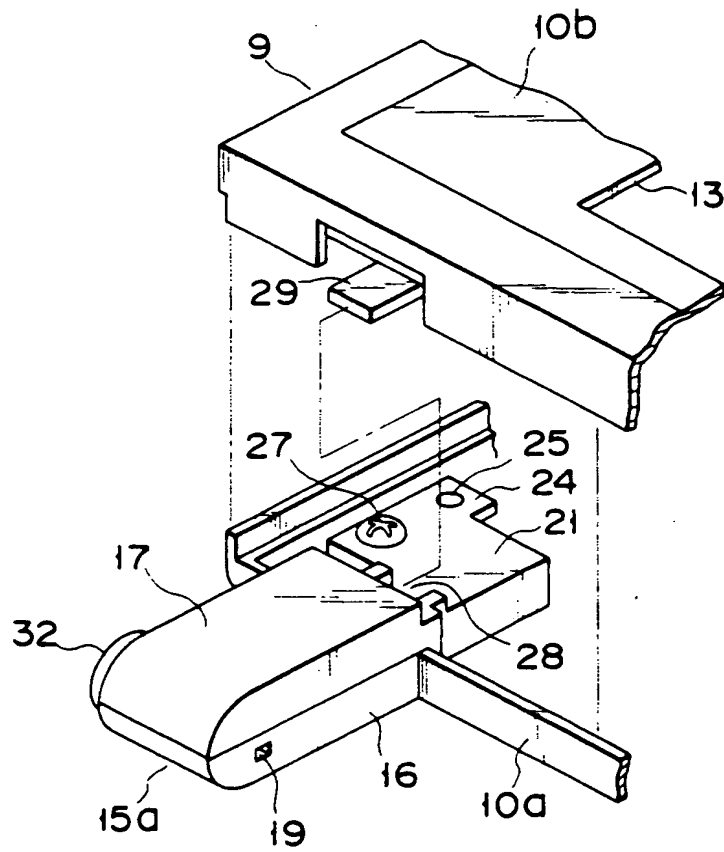


FIG. 8





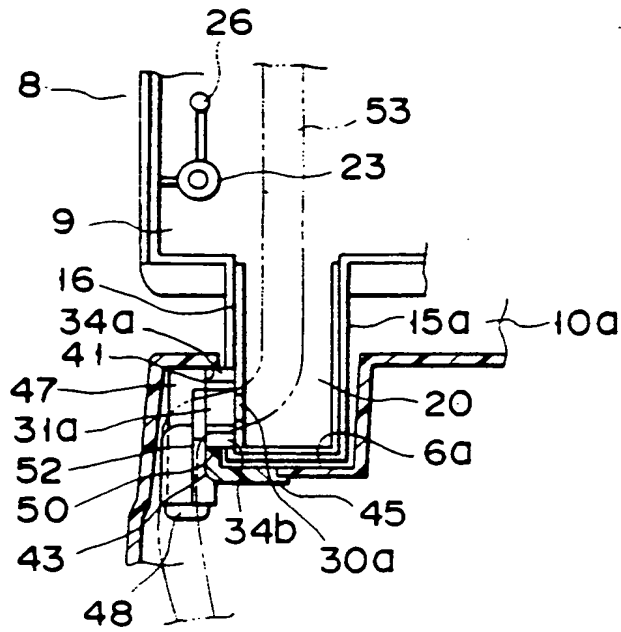


FIG. 9

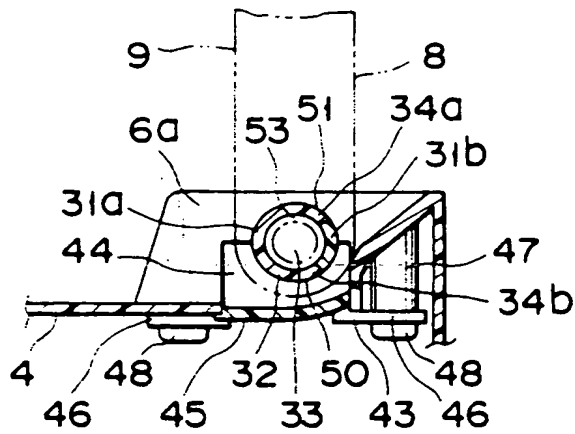


FIG. 10



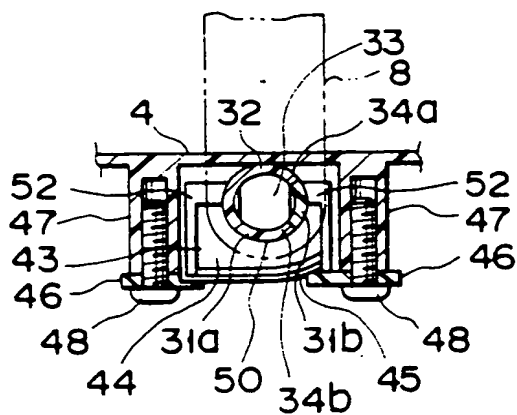


FIG. 11

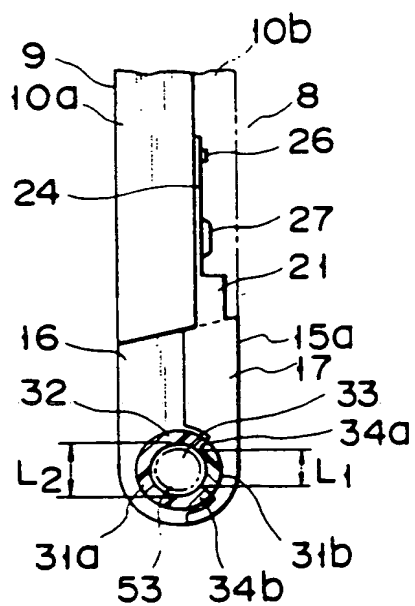


FIG. 12



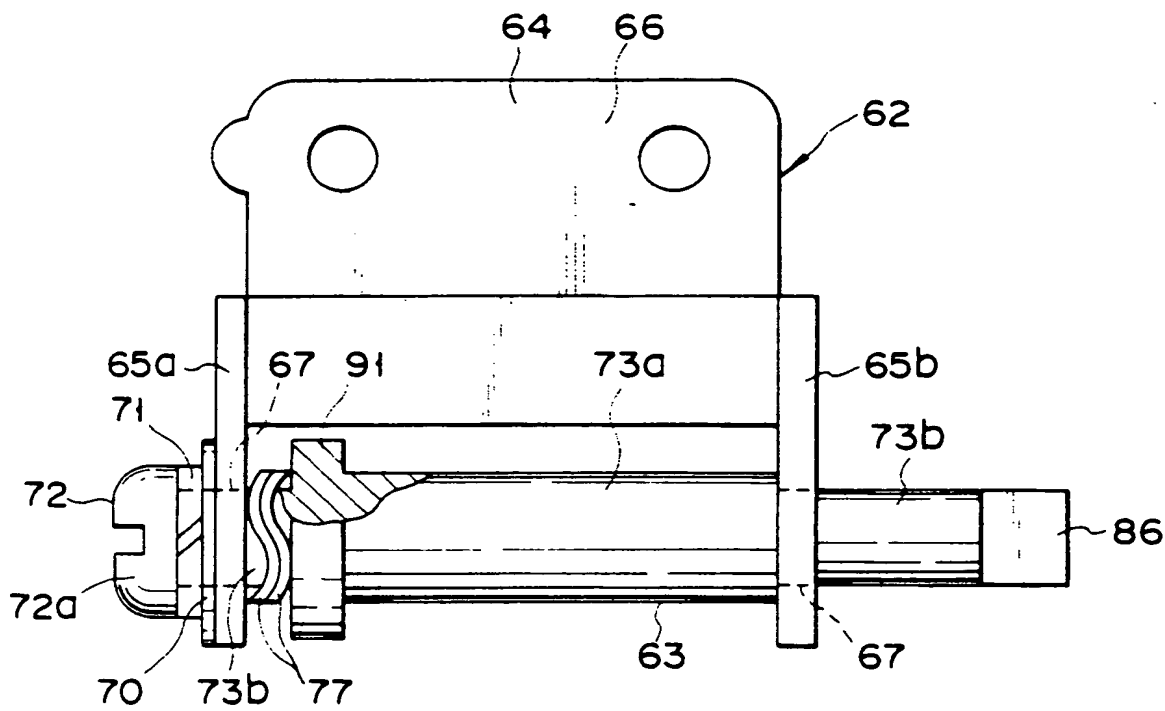


FIG. 13

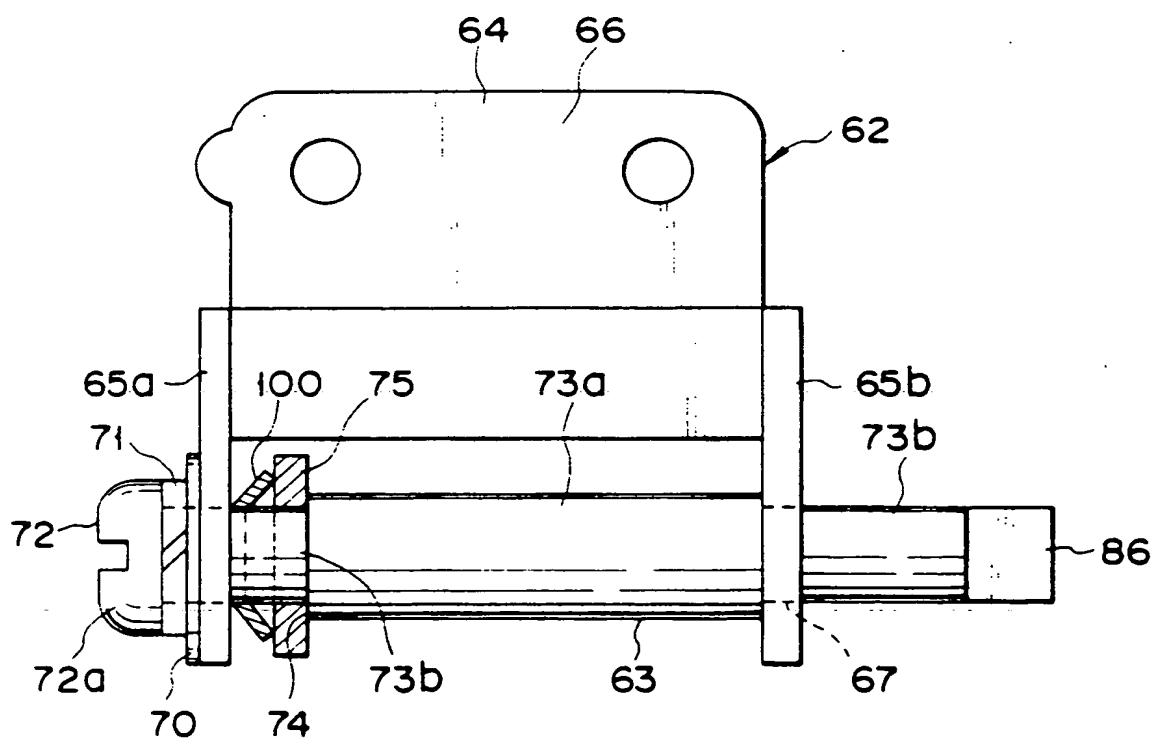


FIG. 14

